

# Water Tank or Water Tower

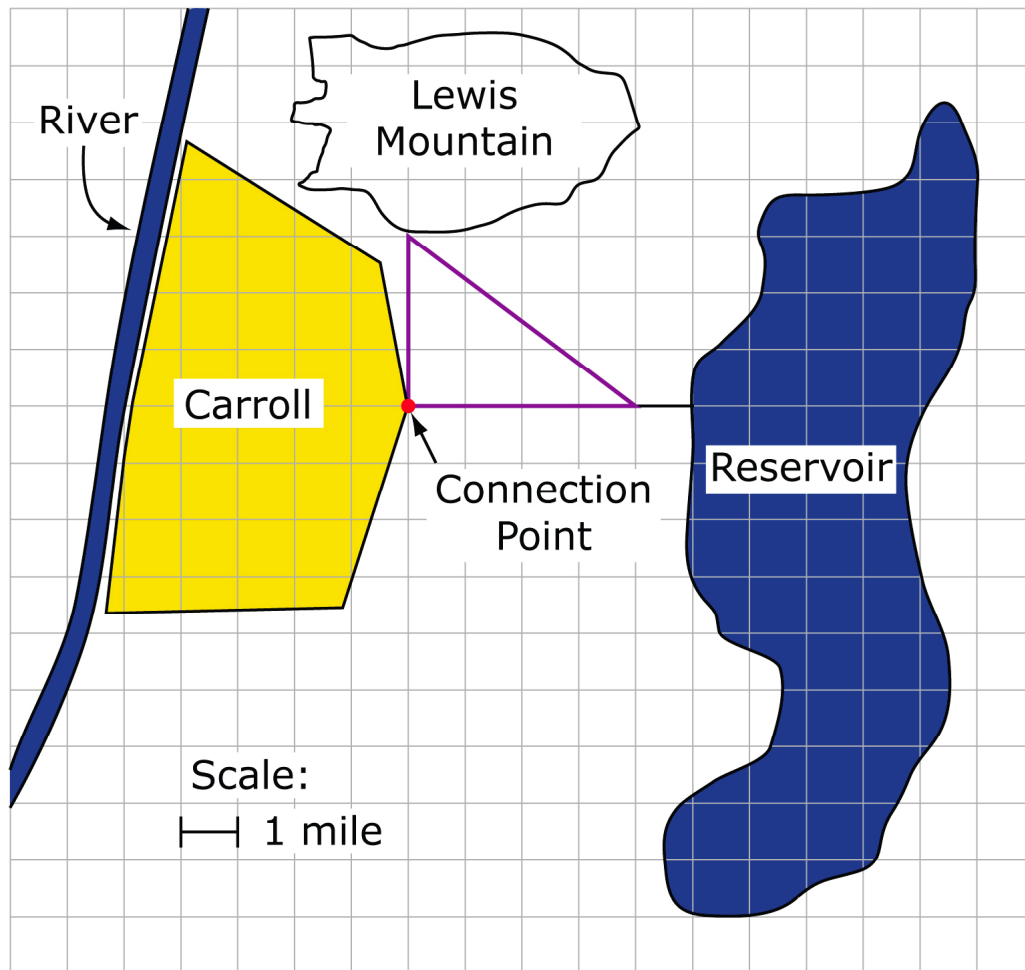
## 8<sup>th</sup> Grade Example

### Session 1

The population of Carroll is approximately 20,000 and has remained constant for the last 20 years. Carroll currently uses an outdated water supply system to get its water from a nearby river. The outdated system will be replaced by a system that draws from a reservoir.

Members of the finance committee on the Carroll town council are responsible for investigating the costs of a new water treatment plant. As one of the finance committee members, you must make a recommendation that will best meet the needs of the town at this time. The two options are as follows:

- Building a water tank on Lewis Mountain
- Building a water tower at a connection point on the edge of town



You must first determine the costs based on the packet of information provided by four companies bidding on the town's new water treatment plant. After analyzing the information provided, you will summarize your findings and write a report to the town council that includes your recommendation. (Packet at end of problem)

To begin, answer the following questions:

## Water Tank or Water Tower

1. How high does the water tank need to be above the highest elevation in town?
2. What is the minimum size of each design (reservoir, Hydrosphere, and Watercolumn) that could be used to meet the needs of the town?
3. What is the cost to construct the minimum size of each design, including the tower if necessary?
4. What is the cost of the pipe for each design?
5. What is the cost of the land for each design?

You have information and estimates from the following companies to help you answer the questions.

- Thomas Tanks & Towers, Inc.
- William Brown Polls
- Nguyen Construction Co.
- Ravi Patel Real Estate

Be sure to clearly label your answers for each question. Show all work necessary to support your answers using diagrams, pictures, expressions/equations, or words as appropriate.

A calculator tool<sup>1</sup> and a spreadsheet tool<sup>2</sup> are available by clicking on the appropriate icon for each in the top right corner. Answers may be written or displayed in the spreadsheet and saved as part of your response.

<sup>1</sup> The technology platform will have to allow for at least a scientific calculator for this task.

<sup>2</sup> The technology platform should allow for a basic spreadsheet interface that can be used, with the results or snapshot of the spreadsheet included as part of the student's response.

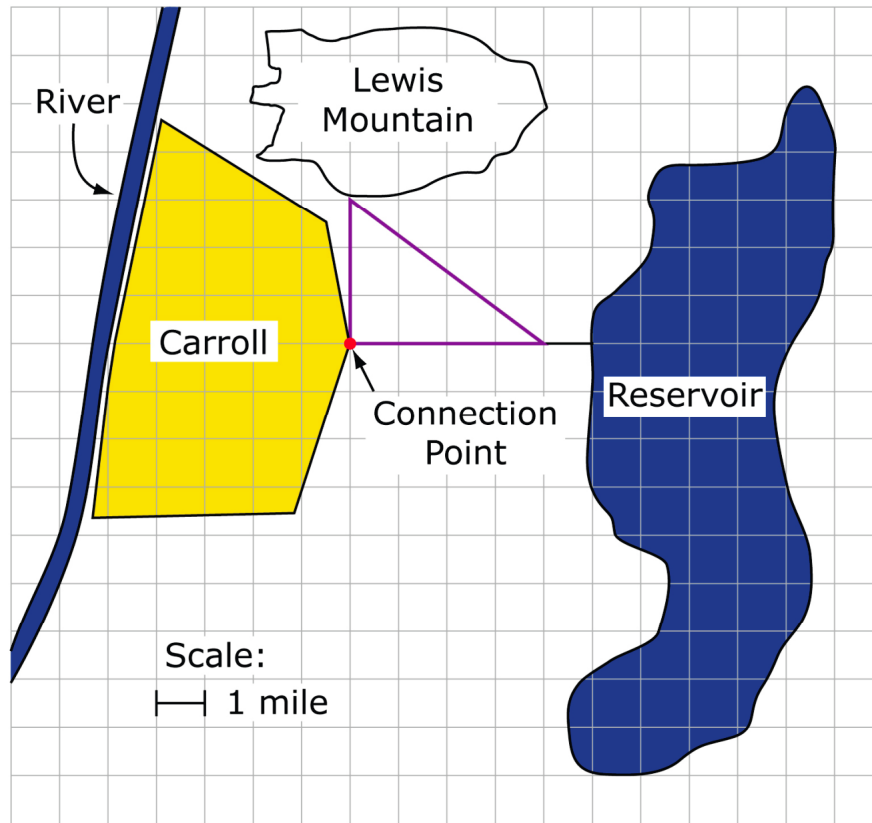
## Session 2

Now that you have determined the costs of the different designs, you need to write your report and make a recommendation to the town council.

The following questions will guide your report. To support your answers to these questions, you must include the following:

- Cost estimates gathered from your work completed in Session 1 of this task
- Survey information provided in the information packet

## Water Tank or Water Tower



6. What are the positives and negatives of building a water tank on Lewis Mountain? Be sure to give the most complete answer that you can.
7. What are the positives and negatives of building a water tower at the connection point? Be sure to give the most complete answer that you can.
8. What are the positives and negatives of building a water tower at the connection point? Be sure to give the most complete answer that you can.

### Information Packets

This packet contains information from Nguyen Construction Co., Ravi Patel Real Estate, William Brown Polls, and Thomas Tanks & Towers, Inc. to be used to determine the costs of the construction of a water tank or water tower for the town of Carroll.

### THOMAS TANKS & TOWERS, INC.

#### Required Tank Height

- For each foot that the base of a water tank is above the highest elevation in town, the water pressure increases by 0.43 pounds per square inch (PSI).

## Water Tank or Water Tower

- The construction costs are \$300 for each foot that the tank is raised above the ground.

### Required Water Pressure

- We recommend maintaining a water pressure between 50 and 100 pounds per square inch (PSI).

### General Notes

- One cubic foot holds approximately 7.5 gallons.
- The cost of a reservoir, Hydrosphere, or Watercolumn does not include the cost to purchase the land, develop the land, or build the tower.

### Ground-Level Cylindrical Reservoir Options

Diameter (feet)	Height (feet)	Cost (dollars)
48	40	\$650,000.00
58	40	\$950,000.00
67	40	\$1,270,000.00
94	40	\$2,500,000.00
115	40	\$3,730,000.00
148	40	\$6,180,000.00



- 10 acres of land are required for a ground-level reservoir.
- A ground-level cylindrical reservoir cannot be constructed on top of a tower.

### HYDROSPHERE WATER TOWER OPTIONS

Diameter (feet)	Cost (dollars)
52	\$1,030,000.00
59	\$1,400,000.00
65	\$1,780,000.00
70	\$2,170,000.00
75	\$2,610,000.00
81	\$3,220,000.00

Base of the  
water tower



- 5 acres of land are required for a Hydrosphere water tower.

## Water Tank or Water Tower

### WATERCOLUMN WATER TOWER OPTIONS

#### NOTES:

- The height of the upper cylindrical section of a Watercolumn is half of the head range.
- The volume of the lower noncylindrical section of the tank in a Watercolumn is 70% of the volume in the upper cylindrical section.

Diameter (feet)	Head Range (feet)	Cost (dollars)
58	32	\$1,060,000.00
64	40	\$1,410,000.00
74	40	\$1,760,000.00
80	40	\$1,990,000.00
90	40	\$2,420,000.00
100	42	\$3,020,000.00
108	44	\$3,610,000.00
120	42	\$4,190,000.00
125	45	\$4,800,000.00
135	45	\$5,540,000.00

Head  
range  
  
Base of the  
water tank



- 5 acres of land are required for a Watercolumn water tower.

### NGUYEN CONSTRUCTION CO.

Based on your requirements, we are pleased to offer an estimate of \$20,000 per acre to develop a site for a water tank or water tower.

This estimate includes:

- Grading and site preparation
- Foundation construction
- Parking lot and sidewalk construction
- Planting of grass seed and native shrubs and trees at the conclusion of the project.

In addition, we estimate the cost to construct the water pipe at \$4,300,000 per mile. If the water tank is constructed on Lewis Mountain, we estimate \$700,000 to build pipes from the bottom of the mountain to the tank.

### RAVI PATEL REAL ESTATE

We have researched the approximate costs for 10-acre parcels of land on Lewis Mountain and 5-acre parcels of land on the edge of the town of Carroll.

## Water Tank or Water Tower

It is reasonable to expect to pay \$9,000 per acre for land on Lewis Mountain. The parcels of land available on the mountain are approximately 150 feet above the highest elevation in town.

We look forward to providing assistance in the purchase of the land needed for this project.

### William Brown Polls

Thank you for allowing us the opportunity to serve your community. The questions used in our survey and the results are shown below.

*Question 1: How strongly do you agree with the following statement? I would prefer for the new water tank to be built on a tower on the edge of town instead of on Lewin Mountain.*

Response	% of the Population
Strongly agree	20%
Somewhat agree	15%
Neither agree nor disagree	10%
Somewhat disagree	10%
Strongly disagree	45%

*Question 2: If the new water tank is built on a tower on the edge of town, what would you like to see in the space on the water tank? A design welcoming people to Carroll, a design featuring the high school mascot, or advertisements?*

Response	% of the Population
A design welcoming people to Carroll	15%
A design featuring the high school mascot	75%
Sell the space for advertising	10%

All percents shown are estimated to be correct within +/- 3%

Please contact us if we can be of further service to your community.